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CHAETOGNATHS COLLECTED BY THE SÔYÔ-MARU IN THE YEARS 1934 AND 1937-1939¹⁾

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With one Text-figure and 2 Tables

About sixty plankton samples collected by the Sôyô-maru, a surveying ship of the Central Fisheries Experimental Station in Tokyo, in the years 1934 and 1937-1939 in the waters chiefly along the Pacific coasts of Japan and China (Fig. 1) were examined for the purpose to contribute to clear up the distribution of chaetognaths in the western part of the Pacific. They were all collected vertically from 50 m to the surface by KITAHARA's quantitative net which is a modified HENSEN's net in miniature, 25 cm in diameter of the mouth and 100 cm in length. The following seventeen species were identified in the present material.

1. *Sagitta hexaptera*
2. *Sagitta enflata*
3. *Sagitta elegans*
4. *Sagitta bipunctata*
5. *Sagitta bedoti*
6. *Sagitta pulchra*
7. *Sagitta ferox*
8. *Sagitta robusta*
9. *Sagitta serratodentata pacifica*
10. *Sagitta serratodentata atlantica*
 f. *pseudoserratodentata*
11. *Sagitta neglecta*
12. *Sagitta regularis*
13. *Sagitta crassa*
14. *Sagitta minima*
15. *Sagitta decipiens*
16. *Pterosagitta draco*
17. *Krohnitta pacifica*

1) Contributions from the Seto Marine Biological Laboratory, No. 301.

The details of the occurrence of respective species are given in Table 2 at the end of this article.

Before going further, I want to express my hearty thanks to Prof. H. AIKAWA who afforded me facilities for examining these samples.

Chaetognaths in Respective Sections of the Surveyed Area

1. *Okhotsk Sea*: Only a single species *Sagitta elegans* occurred.
2. *More northern waters than 40°N*: In the northern waters affected by the cold current "Oyasio", the fauna in the surface water shallower than 50 m is represented solely by *Sag. elegans*. However, in the southern part of this area, where the warm current "Kurosio", the cold current "Oyasio" and probably a considerable amount of the coastal water are mingled one another in various degrees according to the oceanographic conditions, some warm-water species are added to the fauna; among these *Sag. bedoti* is the most dominant one.
3. *Waters off the north-eastern Honsyū, south to 40°N*: In this region where the "Kurosio" encounters with the "Oyasio" and turns to the east, the fauna is characterized by the occurrence of abundant *Sag. bedoti*. Of course, a few specimens of *Sag. elegans* can be found in the northern part of this region. The southern-most record of *Sag. elegans* in the present material was found at St. 5 (34°36' N, 144°04' E) where a single 23 mm long individual was detected in the sample. As the coastal water mass might be induced out by the eastwards strong current, a small number of the coastal-water species *Sag. crassa* are found at some stations far off the coast as shown in the column of St. 5 in the table.
4. *Waters off the south-western Honsyū, including (5) Sagami Bay*: In this region, *Sag. bedoti* occurs more frequently and abundantly at stations near the coast than at far offshore stations. However, it occurs in a considerable number at some stations far south off Kii Peninsula. Possibly, this is due to the fact that the "Kurosio" turns sharply to the south near the south end of Kii Peninsula and flows along a large water mass of slightly lower temperature, which stays there for a long time; and resultantly an anticlockwise current produced along the periphery of this less warm water mass induces out the coastal water to far offshore stations. Usually, the proportion of *Sag. enflata* increases in this area as compared with that in the preceding region and it is the same as to *Sag. serratodentata pacifica*. Fourteen species were identified in samples from this section.
6. *Southern waters off Kyūsyū*: The composition of the fauna is nearly the same as in the preceding section, except for that the proportion of *Sag. bedoti* seems to fluctuate more conspicuously and proportions of *Sag. serratodentata pacifica* and *Sag. robusta* increase considerably in this section.
7. *East China Sea*: Here the occurrence of abundant *Sag. bedoti* at St. 40 and the absence of this species at Stations 120 and 125 are noticeable.

8. *Taiwan Straits*: Eleven species in two samples. *Sag. bedoti* was found in a considerable number.

9. *South China Sea*: *Sag. bedoti* occurs rather numerously at the northern stations near Taiwan Straits, while it decreases rather sharply at the southern stations around Hainan Island. The occurrence of comparatively rich *Sag. robusta* in this region should be noteworthy.

Throughout the whole material, the frequency of occurrence of respective species varies considerably according to sections as shown in Table 1.

Table 1.
Frequency of occurrence of respective species in each section of the surveyed area (0-50m).

Section number	1 (2 samples)	2 (13 sam.)	3 (7 sam.)	4 (13 sam.)	5 (6 sam.)	6 (6 sam.)	7 (4 sam.)	8 (2 sam.)	9 (9 sam.)	Frequency of occurrence throughout the warm-water regions (53 sam.)
1. <i>Sag. hexaptera</i>	—	—	43	38	50	50	—	50	11	30
2. <i>Sag. enflata</i>	—	15	71	85	100	100	75	100	100	83
3. <i>Sag. elegans</i>	100	54	14	—	—	—	—	—	—	2
4. <i>Sag. bipunctata</i>	—	8	29	69	17	50	—	50	11	34
5. <i>Sag. bedoti</i>	—	46	100	92	100	67	50	100	67	85
6. <i>Sag. pulchra</i>	—	—	14	—	—	17	—	—	—	4
7. <i>Sag. ferox</i>	—	—	29	69	67	83	75	100	56	57
8. <i>Sag. robusta</i>	—	8	57	77	50	100	—	100	100	66
9. <i>Sag. serratodentata pacificæ</i>	—	—	43	31	67	83	50	50	33	42
10. <i>Sag. serratodentata atlantica</i> f. <i>pseudoserratodentata</i>	—	—	—	—	33	—	—	—	—	4
11. <i>Sag. neglecta</i>	—	—	14	—	—	—	50	50	44	15
12. <i>Sag. regularis</i>	—	—	—	15	33	—	—	100	11	13
13. <i>Sag. crassa</i>	—	—	14	15	50	17	25	50	22	21
14. <i>Sag. minima</i>	—	—	14	—	17	—	—	—	—	4
15. <i>Sag. decipiens</i>	—	—	—	—	17	—	—	—	—	2
16. <i>Pterosag. draco</i>	—	—	—	15	67	—	—	100	—	15
17. <i>Kitta. pacifica</i>	—	—	—	8	—	—	50	—	22	9
Number of species	1	5	12	11	13	9	7	11	11	

Among the results obtained, the distribution of *Sag. bedoti* seems to be one of the most interesting phenomena. This species occurs commonly in the Indian Ocean and the waters of the Siboga-area and goes to the north along the coast of the continent to the Japanese waters. However, it is practically or quite absent in the water of the North Equatorial Current (TokioKa 1942, 1954 and 1955), although the minor form of this species (*Sag. bedoti* f. *minor*) occurs also in the limited area of the

eastern equatorial Pacific along the western coasts of the Central and northern South Americas (BIERI 1957).

In South China Sea, it is not so abundant as in other waters. For instance, it is recorded from the coastal waters of Annam (SERÈNE 1937), but there it occupies only a small part of the chaetognath fauna (HAMON 1956): the minor form occurred in the Bay of Nhatrang-Cauda at the frequency of 6-76%, but it occupied merely 1(-)~1.7% of the whole population. Around the Philippine Islands, it was found only in four of the forty-six samples collected during the Albatross Expedition 1907-1910 (MICHAEL 1919). However, it increases in number in the northern part of the sea and reaches the dense population in the western half of East China Sea and the southern half of the Yellow Sea (TOKIOKA 1940). The scantiness of the present species in South China Sea may possibly be caused by the influence of the strong influx of the North Equatorial Current which carries no *Sag. bedoti*.

The water of East China Sea and the Yellow Sea may be induced out eastwards by "Kuroshio" in various degrees and supplies *Sag. bedoti* to the coastal waters along the main island of Japan; there the species thrives considerably and the density reaches to the maximum in the area where the warm "Kuroshio" and cold "Oyashio" encounter with each other. Then the species is carried to the east approximately along the 40° N line by the strong eastward current of "Kuroshio", diminishing gradually in number and at last quite disappears in the pure oceanic water of the Pacific. So far as I am aware, the eastern-most limit of the distribution of *Sag. bedoti* is 161°39' E and the northern-most limit is 44°06' N. Many data about the distribution of this species in the "Kuroshio" along the Pacific coast of Japan are now being accumulated in the oceanographic reports published by the meteorological department of Japan and these data seem also to affirm the idea that *Sag. bedoti* occurs, in the surveyed regions, more abundantly near the coast, but decreases remarkably towards the open sea. Thus, it seems very possible that *Sag. bedoti* can be used as an indicator to distinguish the water mass of the Indo-Malayan waters or that along the coasts of China and Japan from the pure oceanic water of the Pacific. The detailed data about this problem will be discussed fully in a future paper.

Situations of Stations

— 1934 —

Station	Date	Situation
6	Aug. 3	37°57' N, 141°32' E
11	Aug. 7	39°48' N, 149°41' E
13	Aug. 8	40°18' N, 151°48' E
15	Aug. 9	40°47' N, 153°53' E
17	Aug. 9	41°15' N, 155°56' E
N	Dec. 13	N.W. off Niizima

— 1937 —

Station	Date	Situation
13	Aug. 13	41°16,0' N, 144°29,5' E
40	Aug. 24	46°10,0' N, 153°26,0' E
57	Sept. 3	49°52,0' N, 153°41,0' E
68	Sept. 6	45°03,5' N, 145°38,0' E
71	Sept. 8	43°19,0' N, 146°24,0' E
78	Sept. 14	38°13' N, 142°19' E (off Kinka-zan)

— 1938 —

2	May 19	33°35,7' N, 138°09,5' E
7	May 21	31°05,0' N, 138°24,0' E
23	May 28	32°34,5' N, 136°04,0' E
29	May 29	30°13,3' N, 136°41,2' E (near Kinan-syô)
47	Jun. 3	31°31,2' N, 134°12,5' E
48	Jun. 4	30°48,5' N, 134°08,5' E
52	Jun. 5	29°50,5' N, 133°21,5' E
72	Jun. 10	31°05,8' N, 132°32,3' E
84	Jun. 18	29°30,0' N, 131°45,0' E
95	Jun. 22	28°50,9' N, 130°57,0' E
98	Jun. 22	29°47,8' N, 130°53,8' E
103	Jun. 23	30°45,0' N, 130°42,1' E
5	Aug. 7	34°36,0' N, 144°04,0' E
9	Aug. 8	37°58,0' N, 144°06,5' E
13	Aug. 10	41°16,5' N, 144°13,0' E
37	Aug. 20	45°25,0' N, 150°02,0' E
43	Aug. 22	46°48,3' N, 153°50,5' E
46	Aug. 23	49°14,2' N, 157°05,0' E
60	Aug. 30	44°53,0' N, 149°23,0' E
77	Sept. 9	39°03,0' N, 142°46,0' E

— 1939 —

5	Jun. 5	32°55,0' N, 138°02,5' E
10	Jun. 6	30°52,0' N, 136°11,0' E
18	Jun. 8	33°18,0' N, 135°36,5' E
21	Jun. 8	32°22,5' N, 134°32,5' E
25	Jun. 9	31°16,7' N, 132°43,2' E
30	Jun. 12	30°51,2' N, 130°22,0' E
35	Jun. 12-13	30°05,5' N, 127°30,0' E
40	Jun. 16	29°41,0' N, 125°09,5' E

Station	Date	Situation
50	Jun. 21	25°31,6' N, 121°44,6' E
55	Jun. 24	25°00,5' N, 120°30,5' E
59	Jun. 26	23°34,0' N, 118°46,8' E
65	Jun. 29	21°45,0' N, 115°32,0' E
70	Jul. 2	20°30,0' N, 113°00,0' E
75	Jul. 2	20°14,7' N, 110°58,1' E
80	Jul. 6	20°55,0' N, 108°31,5' E
84	Jul. 7	18°35,0' N, 108°01,8' E
88	Jul. 7	17°00,0' N, 109°01,0' E
92	Jul. 10	17°15,3' N, 110°29,8' E
95	Jul. 11	18°16,0' N, 111°07,8' E
120	Jul. 23	25°26,0' N, 124°01,0' E
125	Jul. 24	25°55,0' N, 126°35,0' E
21	Aug. 29	42°05,0' N, 148°49,0' E
26	Aug. 31	41°58,5' N, 154°14,0' E
77	Sept. 19	38°57,0' N, 143°00,0' E

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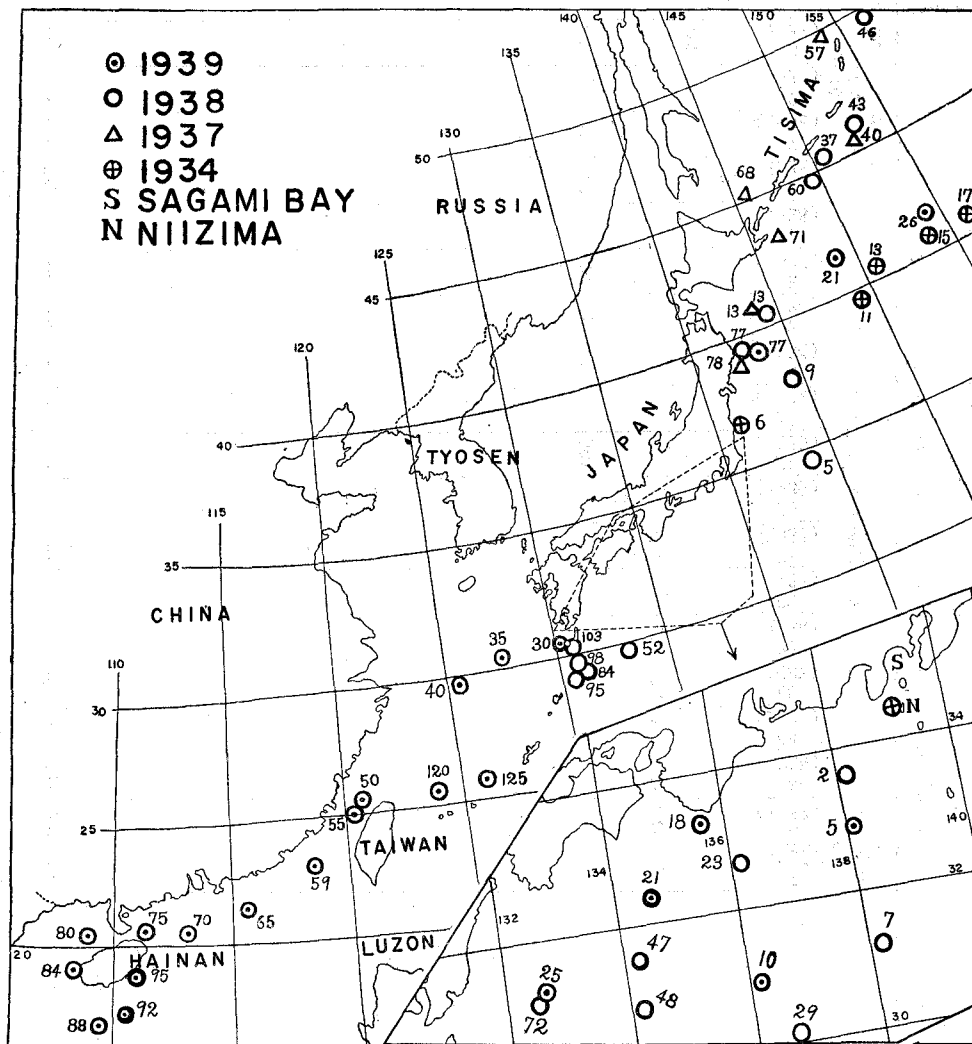


Fig. 1. Chart showing stations in the surveyed area.

Table 2. Detail of the occurrence of chaetognaths at respective stations.

	1. Okhotsk sea		2. More northern waters than 40°N.														3. Waters off the north-eastern Honsyû, south to 40°N.						
	57 (1937)	68 (1937)	46 (1938)	43 (1938)	40 (1937)	37 (1938)	60 (1938)	71 (1937)	26 (1939)	21 (1939)	17 (1934)	15 (1934)	13 (1934)	13 (1937)	13 (1938)	11 (1934)	77 (1938)	77 (1939)	78 (1937)	9 (1938)	6 (1934)	5 (1938)	
1. <i>Sag. hexaptera</i>										1						6				12		1	
2. <i>Sag. enflata</i>														16		7		3	238	30		32	
3. <i>Sag. elegans</i>	24	189	424	356	210	28	2	182			14											1	
4. <i>Sag. bipunctata</i>									2										1			2	
5. <i>Sag. bedoti</i>									1	150		9	33	82	9	368	525	98	489	19	1	40	
6. <i>Sag. pulchra</i>																			2				
7. <i>Sag. ferox</i>																				35		24	
8. <i>Sag. robusta</i>															1	4			2	3		6	
9. <i>Sag. serratodentata pacifica</i>																7				24		40	
10. <i>Sag. serratodentata atlantica</i> f. <i>pseudoserratodentata</i>																							
11. <i>Sag. neglecta</i>																			3				
12. <i>Sag. regularis</i>																							
13. <i>Sag. crassa</i>																							
14. <i>Sag. minima</i>																			1			2	
15. <i>Sag. decipiens</i>																							
16. <i>Pterosag. draco</i>																							
17. <i>Ktta. pacifica</i>																							
18. Damaged individuals or juv.																						3	
Total	24	189	424	356	210	28	2	182	3	151	14	9	33	98	10	392	525	101	735	124	1	151	

Table 2. (Continued.)

	4. Waters off the south-western Honsyū														5. Sagami Bay				
	N (1934)	2 (1938)	5 (1939)	7 (1938)	18 (1939)	23 (1938)	10 (1939)	29 (1938)	21 (1939)	47 (1938)	48 (1938)	25 (1939)	72 (1938)	(1934)	F2 1934 (Dec. 13)	(1934 Dec. 13)	A	B	C
1. <i>Sag. hexaptera</i>	1			6				1	7	1				2				3	1
2. <i>Sag. enflata</i>	33	6	2	12	6		7		3	5	9	2	17	28	64	5	8	9	6
3. <i>Sag. elegans</i>																			
4. <i>Sag. bipunctata</i>	2	23	20		5		2		4		5	30	20	5					
5. <i>Sag. bedoti</i>	3	432	1	13	41	1	65	1	6		2	2	1	17	143	3	6	6	31
6. <i>Sag. pulchra</i>																			
7. <i>Sag. ferox</i>	3	39	10	1	1		4				2	3	2	8			1	1	1
8. <i>Sag. robusta</i>	3	32	9	4	1	1		1	2			3	2	28	6				5
9. <i>Sag. serratodentata pacifica</i>				4			1				9		7	28	59			3	9
10. <i>Sag. serratodentata atlantica</i> f. <i>pseudoserratodentata</i>																	3		2
11. <i>Sag. neglecta</i>																			
12. <i>Sag. regularis</i>	2			1													2	1	
13. <i>Sag. crassa</i>		2		1										1	2			? 2	
14. <i>Sag. minima</i>																			1
15. <i>Sag. decipiens</i>																		2	
16. <i>Pterosag. draco</i>			1	2										2			3	3	3
17. <i>Ktta. pacifica</i>													2						
18. Damaged individuals or juv.		3						2						7	1		2	2	
Total	47	537	43	44	54	2	79	5	22	6	27	40	51	126	275	8	25	32	59

Table 2. (Continued.)

	6. Southern waters off Kyûsyû						7. East China Sea (1939)				8. Taiwan Straits (1939)		9. South China Sea (1939)										
	30 (1939)	103 (1938)	98 (1938)	84 (1938)	95 (1938)	52 (1938)	35	40	120	125	50	55	59	65	70	75	80	84	88	92	95		
1. <i>Sag. hexaptera</i>	4			1	10						1									? 1			
2. <i>Sag. enflata</i>	21	49	5	9	19	2	18	6	20		30	158	46	3	12	256	153	39	1	7	4		
3. <i>Sag. elegans</i>																							
4. <i>Sag. bipunctata</i>		5		4		58						1			4								
5. <i>Sag. bedoti</i>	2	37	16		1		1	137			74	58	241	4	36			1		2	1		
6. <i>Sag. pulchra</i>	1																						
7. <i>Sag. ferox</i>	1	9	1		6	1	2		8	30	12	1	1	1	22					2	64		
8. <i>Sag. robusta</i>	6	2	6	9	11	7					6	45	1	3	103	53	3	89	16	63	14		
9. <i>Sag. serratodentata pacifica</i>	5	3	14	19		5			12	13		6	1		23						1		
10. <i>Sag. serratodentata atlantica</i> f. <i>pseudoserratodentata</i>																							
11. <i>Sag. neglecta</i>									8	87	2			1		4	42		24				
12. <i>Sag. regularis</i>											1	1	1										
13. <i>Sag. crassa</i>			3					1			10		8		? 1								
14. <i>Sag. minima</i>																							
15. <i>Sag. decipiens</i>																							
16. <i>Pterosag. draco</i>											1	1											
17. <i>Ktta. pacifica</i>									16	7									1	1			
18. Damaged individuals or juv.		1										1						1					
Total	40	106	45	42	47	73	21	144	64	137	137	272	299	12	200	314	198	130	42	76	84		